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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/757,028	01/13/2004	Shanqi Zhao	1138-92	3263
20575	7590	06/01/2005	EXAMINER	
MARGER JOHNSON & MCCOLLOM, P.C. 1030 SW MORRISON STREET PORTLAND, OR 97205			PHAM, LONG	
			ART UNIT	PAPER NUMBER
			2814	

DATE MAILED: 06/01/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

AK

Office Action Summary

Application No.

10/757,028

Applicant(s)

ZHAO ET AL.

Examiner

Long Pham

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☐ Responsive to communication(s) filed on ____.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 9-27 is/are pending in the application.
- 4a) Of the above claim(s) 14-16, 18 and 19 is/are withdrawn from consideration.
- 5) ☐ Claim(s) ____ is/are allowed.
- 6) ☒ Claim(s) 9-13, 17, 20, 21, 24, 25 and 26 is/are rejected.
- 7) ☒ Claim(s) 22, 23 and 27 is/are objected to.
- 8) ☐ Claim(s) ____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 17 May 2004 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. ____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date 1/13/04, 09/29/04.
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. ____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☒ Other: IDS 01/26/05.

DETAILED ACTION

Election/Restrictions

1. Applicant's election without traverse of claims 9-13, 17, 20-22, 23-25, and 26-27 in the reply filed on 05/12/05 is acknowledged.

Claim Objections

2. Claim 17 is objected to because of the following informalities: claims 13 and 17 are identical. Appropriate correction is required.
3. Claims 24 and 25 are objected to because of the following informalities: claims 24 and 25 can only depend on lower numbered claims, such as 1, 2, 3, 4... 23. Appropriate correction is required.

Claim Rejections - 35 USC § 112

4. The following is a quotation of the second paragraph of 35 U.S.C. 112:
The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.
5. Claim 25 recites the limitation "the deeply placed P+ diffusion" in line 3. There is insufficient antecedent basis for this limitation in the claim.
6. Claim 12 recites the limitation "the amount of additional charge" in lines 1 and 2. There is insufficient antecedent basis for this limitation in the claim.
7. Claim 12 recites the limitation "the starting epitaxial layer" in lines 2 and 3. There is insufficient antecedent basis for this limitation in the claim.

Claim Rejections - 35 USC § 103

8. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:
(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious

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at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

9. Claims 9, 10, 11, 12, 13, 17, 26, 21, 24, and 25 are rejected under 35 U.S.C. 103(a) as being unpatentable over the applicant's admitted prior art (AAPA) of this application in combination with Shenoy (US patent 6,737,731), Hagino (US patent 5,086,324).

With respect to claim 9, AAPA teaches a fabrication process for making an enhanced avalanche ruggedness Fast Recovery Diode, the process comprising of (see figs. 1(a) and 9 and associated text of specification of this application):

selecting a semiconductor material 14 of a first dopant type (N);
patterning and introducing a first dopant of a second type (P) opposite in polarity to the first dopant type into the top surface of the semiconductor material at a peripheral region of the device;
diffusing said first dopant to create field spreading structures 24 for blocking reverse voltage;
introducing and diffusing a second dopant 22 of the second type to a predetermined depth in the semiconductor material to form a pn junction between the semiconductor material and the second dopant; and
completing the device by forming metal electrodes (anode and cathode) on the top surface and backside of the semiconductor material to conduct current through the diode.

AAPA fails to teach introducing and diffusing a third dopant of first type (N) into a central portion of the semiconductor material to form a region and introducing and diffusing the second dopant within the region of the third

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dopant to form a pn junction between the region of the third dopant the second dopant.

Shenoy teaches a power diode in which a dopant of n type is introduced and diffused into a semiconductor material 14 of n type to form a region 15 and a dopant of p type is introduced and diffused into a central of semiconductor material within the region 15 to form a region 16 to form a pn junction between the region 15 and region 16. See fig. 1 and associated text of Shenoy.

It would have been obvious to one of ordinary skill in the art of making semiconductor devices to incorporate the teaching of Shenoy into the process of AAPA to minimize the carrier concentration around the pn junction to lower reverse recovery current. See col. 4, lines 1-5 of Shenoy.

With respect to claims 10, 11, and 12, AAPA in combination with Shenoy fail to teach the ranges for the concentration and depth of second and third dopants and the additional charge concentration.

However, it would have been obvious to one of ordinary skill in the art of making semiconductor devices to determine the workable or optimal values or ranges for the concentration and depth of the second and third dopants and the additional charge concentration through routine experimentation and optimization to obtain optimal or desired device performance because they are result-effective variables and there is no evidence indicating that they are critical or produce any unexpected results and it has been held that it is not inventive to discover the optimum or workable ranges of a result-effective variable within given prior art conditions by routine experimentation. See MPEP 2144.05.

With respect to claims 13, 17, 26, AAPA in combination with Shenoy fail to teach introducing life-time control dopant by diffusion or irradiation into the semiconductor to control device speed.

Hagino teaches introducing life-time control dopant by diffusion or irradiation into the semiconductor to increase device speed. See col. 11, lines 45-60.

It would have been obvious to one of ordinary skill in the art of making semiconductor devices to incorporate the teaching of Hagino into the process of AAPA, Shenoy, and Hagino to increase device speed.

With respect to claim 21, AAPA further teaches the semiconductor material comprises a lightly doped epitaxial layer 14 on top of a heavily doped substrate 12. See fig. 1(a).

With respect to claims 24 and 25, AAPA in combination with Shenoy and Hagino teach forming diode having a pn junction but fail to teach that forming the diode in a region of a MOS gate-controlled device.

However, It would have been obvious to one of ordinary skill in the art of making semiconductor devices form the diode of AAPA, Shenoy, and Hagino in a MOS gate-controlled device to obtain a structure having a diode with enhanced avalanche ruggedness.

Allowable Subject Matter

10. Claims 20, 22, 23, and 27 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Long Pham whose telephone number is 571-272-1714. The examiner can normally be reached on M-F, 7:30AM-3:00PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wael Fahmy can be reached on 571-272-1705. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Long Pham

Primary Examiner

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LP